

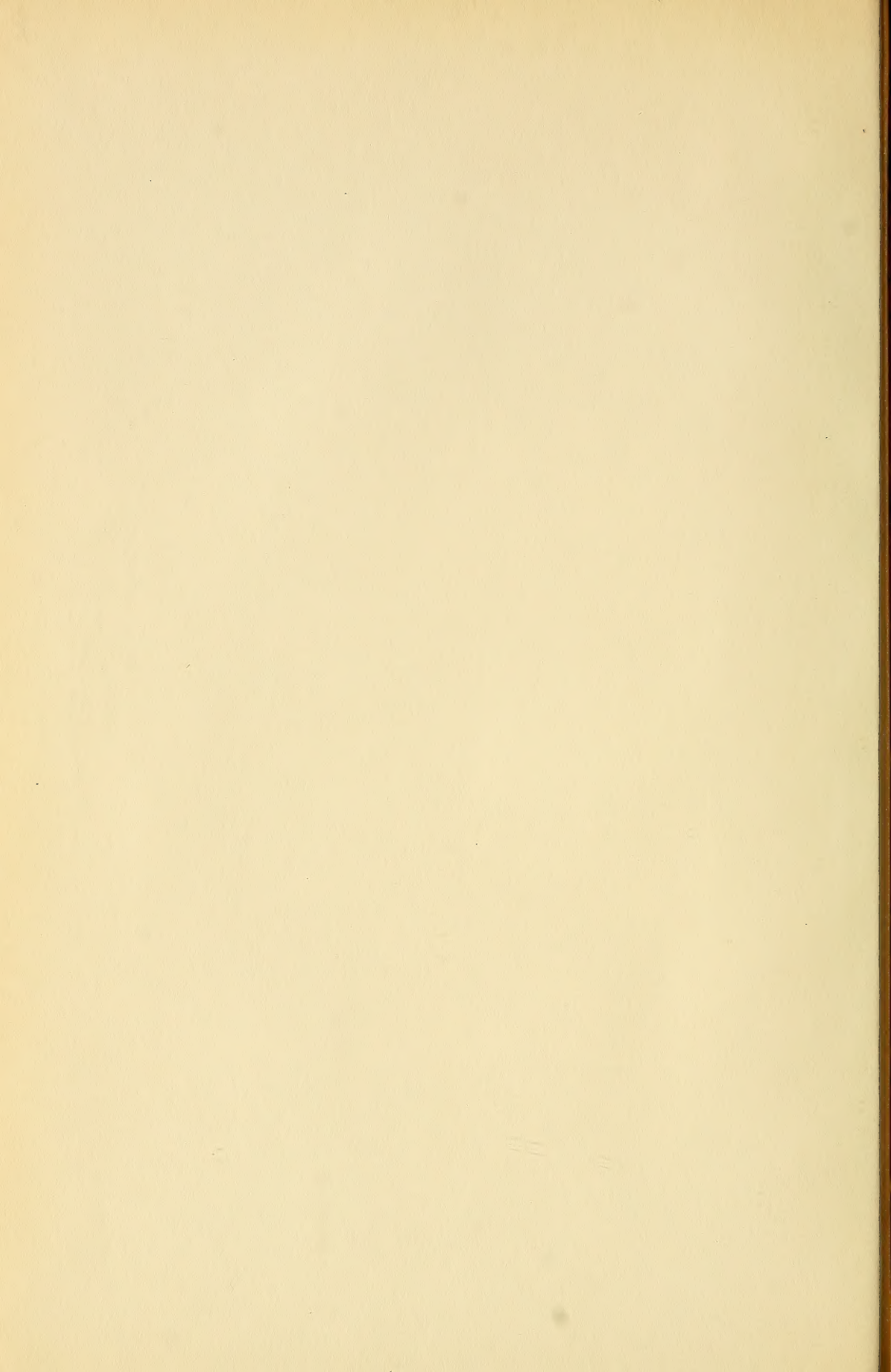
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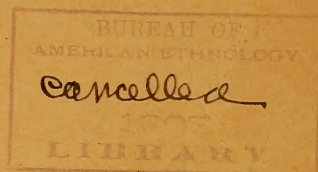
BULLETIN

OF THE

New York State Museum

Vol. 3 No. 13

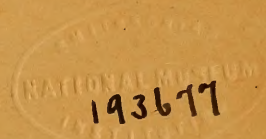
April, 1895



THE SAN JOSE SCALE, *Aspidiotus perniciosus*
AND
SOME OTHER DESTRUCTIVE SCALE-INSECTS
OF THE STATE OF NEW YORK

BY

J. A. LINTNER, Ph. D., STATE ENTOMOLOGIST



ALBANY

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WHAT SCALE INSECTS ARE

There is a large class of small insects — some, indeed most, of which require a magnifying glass for their observation, which are particularly detrimental to fruit-culture, yet from their inconspicuous appearance usually escape notice until discovered when search is made for the cause of the languishing condition or death of the tree or shrub infested by them. Even then it is rather difficult to believe that the true cause has been found in what often seems to be merely an unnatural roughening of the bark or a moderate incrustation formed upon the surface.

The species more commonly met with (the Diaspinæ) have received the name of *bark-lice*, from the appearance of the young as they travel over the bark for a few days after they are hatched; and of *scale-insects*, from the scale-like covering secreted by the insect and beneath which it is hidden after it has fastened itself to the bark. Scientifically, they, together with the “mealy-bugs,” are known as Coccidæ. In classification they have place in that division of the Hemiptera (a large order of suctorial insects) known as Homoptera, the wings being of a uniform thickness throughout, and thereby distinguishing them from the other division (Heteroptera) in which the front wings are thickened in their basal half to a degree, often, approaching the elytra or wing-covers of beetles. It is to this last-named Division that the popular name of “bugs” has become attached. All of the Hemiptera are suctorial, and take their food through a beak or proboscis instead of by biting jaws. They differ greatly in their structure, and in modes of development; the latter, in some of the families, as in that of the Aphididæ or plant-lice, is of intense interest.

The development of the Coccidæ is quite peculiar. The females do not become perfected into winged creatures, but with age assume the form of scales or galls, or of grubs covered with wax or powder; or become degraded beneath their sheltering scale into barely more than egg-sacs, retaining only such simple organs as are essential to their life during the reproduction of their young. The male, however, undergoes a complete transformation and becomes winged, but with only a single pair of wings of very simple structure (see in Figures 3, 2 and 3 in Plates I, II and VII). It lives but a day

or two, dying speedily after the fulfilment of the purpose of its being. It takes no food, for in this stage it possesses no mouth or digestive organs.

A few species of the Coccidæ are of service to us, such as the *Coccus cacti* from which the valuable dye, cochineal, is obtained; the *Carteria lacca* which excretes the material known to us as shell-lac; from another species we have the commercial article known as china wax; and still another species occurring in Arabia produces a solidified honey-dew called "manna," which "is thought by some to have been the heaven-sent manna that nourished the Hebrews in their wanderings."

About 125 species of North American Coccidæ have been described, and others are being brought to notice each year, either from having been previously overlooked, or recently introduced from abroad. All of them are destructive in proportion to their rapidity of multiplication and the greater or less economic importance of the plants that they infest.

SOME DESTRUCTIVE SCALE-INSECTS OF THE STATE
OF NEW YORK

Before proceeding to the consideration of the San José scale,—the subject of this bulletin, it may be of service to refer briefly to a few other species which, although common in the State of New York, and quite harmful to the trees that they infest, are still almost wholly unknown to the fruit-grower and to others who are suffering from their presence. From the figures given of them, they may at once be distinguished from the San José scale.

THE APPLE-TREE BARK-LOUSE

The most common of these is the apple-tree bark-louse, shown in Fig. 1 of Plate I, in its natural size as it occurs on the bark of trunks and limbs, often more abundantly than is represented in the cut, completely covering the bark and overlaying one another, and lending an increased diameter to the infested twig. The color of the scale is brown or ash-gray, nearly approaching that of the bark. The female scale measures about one-twelfth of an inch in length, of a long, usually more or less curved form, pointed at one end on which a magnifier may show the yellowish cast-off skin of the insect, and rounded at the other end. From its peculiar shape it has been frequently written of under the name of the oyster-shell bark-louse. It bears the scientific name of *Mytilaspis pomorum* Bouché. The male scale is of a considerably smaller size, the sides nearly straight, less rounded at the larger end, and of a brighter color. It will seldom be found associated with the females on the bark, as its natural place is on the leaves on either side, especially along the midrib (Riley). If a recent uninjured female scale be carefully lifted after oviposition—at any time during the winter—from fifty to a hundred small, oval, white eggs may be found underneath it, which would ordinarily give out the young insect about the first of June in the latitude of New York.

This destructive scale is far from being confined to the apple, but may also be found on the plum, pear, raspberry, wild gooseberry, wild cherry, red currant, sugar and swamp maples, white and black ash, birch, poplar, willows, linden, horse chestnut, elm, &c. It will be seen from the above, that it has a large number of host-plants.

THE SCURFY BARK-LOUSE

This scale-insect, known to science, as *Chionaspis furfurus* (Fitch), is quite common in the State of New York, where, it is believed to be more numerous and more injurious than in any other of the United States. I have recently seen an orchard of the Kieffer pear, in Columbia Co., N. Y., in which the trunks, of from three to four inches in diameter, were so thickly coated with the scales that at a little distance they appeared as if they had been whitewashed.

The scale, as it appears when scattered over the bark, and the male and female scales magnified, are shown in Fig. 2 of Plate I. The young larva, the mature female, the male pupa, and the male, are represented in Figure 3 of the same Plate, which has been prepared under the supervision of Mr. L. O. Howard, of the Entomological Division at Washington, to illustrate the insect in his article on the "Scale Insects of the Orchard" shortly to appear, and kindly furnished for use in this Bulletin by consent of the Department of Agriculture in advance of its own publication.

Dr. Fitch has described so faithfully the appearance of a badly infested tree and of the scale, that his account is transcribed herewith: "The bark of the limb [pear tree] was covered with an exceedingly thin film, appearing as if it had been coated over with varnish, which had dried and cracked and was peeling off in small irregular flakes, forming a kind of scurf or dandruff on the bark. In places this pellicle was more thick and firm, and elevated into little blister-like spots of a white and waxy appearance, of a circular or broad oval form, less than the tenth of an inch in diameter, abruptly drawn out into a little point at one end, which point was stained of a pale yellowish color and commonly turned more or less to one side." This refers to the female scale, shown in enlargement at *c* of Figure 2, Plate I. The male scales, which usually congregate by themselves (enlarged at *d* in same figure), are only from one-fourth to one-third as large, narrow, usually straight, three-ribbed, and of a snowy-white color. The eggs found beneath the scales are of a purplish-red color. They hatch about the first of June.

This scale attacks the apple, pear, black cherry, choke cherry, and mountain ash. I have recently found it abundantly on the Japan

quince, *Pyrus japonica*, in Washington Park, Albany, — large plots of which were being killed by it.

THE PINE-LEAF SCALE-INSECT

This is another white scale which is quite conspicuous on the leaves of the pine and the spruce on which it occurs. It attacks mainly transplanted trees, and had not been seen by Dr. Fitch, when described by him, on those growing spontaneously in the Forests. The foliage of a large number of Austrian pines (*Pinus Austriaca*) growing in Washington Park, in Albany, a few years ago, was so thickly covered with the scales that it was literally whitened with their myriads. Hundreds could be counted on a single leaf. Nearly all of the infested trees were taken up and burned. Large numbers of the scales were eaten into and destroyed by a little lady-bug, — “the twice-stabbed lady-bird,” — and to the abundant presence of this scale-eating insect, may be owing the fact that in late years the scale has been far less destructive (see *Fifth Report Insects of New York*, 1889, page 266).

The scale is represented in Fig. 1 of Plate II, in natural size upon the leaves, and much enlarged, beneath. They are of an elongate oval form, of a pure white color with a waxy lustre, and with the conspicuous yellow cast skins resting on the smaller end. Dr. Fitch, in his Second Report, 1856, has devoted a half-dozen pages to the insect and its lady-bug destroyer.

THE WHITE SCALE

A troublesome scale frequently infests conservatories and house plants, which may be recognized from the representation of infested leaves and the magnified scales shown in Fig. 2 of Plate II.

The scales are white and are sometimes so abundant as to give a whitewashed appearance to the trunks of the trees that they infest. It is known, in science, as *Aspidiotus nerii* Bouché. Its specific name of *nerii* is drawn from the botanical name of the oleander, *Nerium*, which is one of its favorite food-plants. Ivy, when grown within doors, is quite subject to its attack, and is liable to be killed by it unless care is taken to prevent the multiplication of the scale. Professor Comstock reports having studied the species on the following named plants: Acacia, magnolia, oleander, maple,

Yucca, plum, cherry, currant, English ivy, and lemons from the Mediterranean.

The scale of the female is nearly circular, flat, whitish or light gray, with the dull orange exuviae (cast skins) central or nearly so. The ventral scale (as distinguished from the exuviae) is a mere film applied to the bark. Diameter when full-grown, one-twelfth of an inch. The male scale is snowy-white, slightly elongated with the light yellow larval skin nearly central—diameter one-half that of the male. It is distributed over all the United States, and over much of Europe.

THE MAPLE-TREE SCALE-INSECT

This is one of our largest scale-insects, and, at the time of hatching of the eggs in late June and early July, is more conspicuous than any other found in this part of the United States. It is observed more frequently upon the soft maple, *Acer dasycarpum*, than elsewhere, but it is often found infesting grapevines where it is known as the grapevine bark-louse. It was described forty years ago as *Coccus innumerabilis*—(now included in the genus *Pulvinaria*)—the specific name applicable both to the myriads in which it appears in some localities and to the immense number of eggs produced by the female: often a thousand or more can be counted from underneath a single scale. Fig. 1 of Plate III illustrates the scale as it appears when attention is usually drawn to it. It is then seen as a white, cottony mass of from three- to nearly four-tenths of an inch long, about one-half so broad, of a sub-oval form, bearing upon the narrower end a brown scale darker at the margin, somewhat flattened down or bent upward near its middle to nearly a right angle, oval, broader behind, where it is notched and apparently cleft for a short distance on its middle: on the front is a medial ridge for about one-fourth or one-third its length: it usually shows five transverse wrinkles or folds and about the same number of raised lines running outwardly on each side to the hinder margin. A common appearance of the adult scale is shown at *b* of Fig. 3 of Plate III, and at *a*, *b* and *c*, immature forms in Fig. 4.

The white cotton-like mass, which is a characteristic of the genus *Pulvinaria*, is a secretion thrown out by the insect for the protection of its eggs, and also of the young insects for a short time after their hatching.

In Fig. 2 of Plate III (after Walsh and Riley) the scales and egg-masses are shown on osage-orange as *Lecanium Macluræ*, and on maple as *L. acericola*, but both now referred to *P. innumerabilis*.

This scale had become very abundant upon the maples in the streets of Brooklyn in 1890, and was reported as having killed a large number of the infested trees.* In 1884, it was excessively abundant and quite destructive over the larger part of the State of Illinois. Further particulars of it, and available remedies, may be found in the *Sixth Report on the Insects of New York*, 1890, pp. 141-147.

THE PLUM-TREE SCALE-INSECT

In Plate IV, the plum scale is shown, — an apparently new and destructive plum pest, which has during the past year made its appearance in different localities in the State of New York, particularly in its western portion. Examples of it were received by me on May 14th and 15th from Dr. Collier of the Geneva Agricultural Experiment Station, and from C. M. Hooker and W. C. Barry, of Rochester. No record could be found of its previous occurrence as infesting the plum. Upon submitting it to Prof. T. D. A. Cockerell, of Las Cruces, New Mexico, who has made special study of scale insects, it was determined by him, with a possible doubt, as *Lecanium juglandis* Bouché. This determination has not been accepted by some entomologists, while as an explanation of difference of opinion in regard to it, it has been suggested that two closely resembling species are associated on the infested trees.

The species of *Lecanium* are large, conspicuous scales, as may be seen covering the branch in the figure, approaching a half globe in form, and in the season of reproduction, containing within their capacious bodies a very large number of eggs — a thousand, or it may be two thousand or more. From their rapidity of multiplication they may prove very injurious to the trees that they infest, but fortunately their size, and their tenderness during a portion of their existence, exposes them to parasitic attack, and to destruction from certain weather conditions. They are amenable to treatment with kerosene emulsion, and to the methods which will be recommended for the destruction of the San José scale.

* *Eighth Report on the Insects of New York*, 1893, page 177.

Prof. M. V. Slingerland, of the Cornell University Experiment Station has made a study of this insect in the plum orchards of Western New York, the results of which are published in Bulletin 83 of the Station — describing it, narrating its destructiveness, naming the few plants upon which it is believed to have passed from the plum, its life-history, its natural enemies, and approved methods for combatting it.

This scale has been found abundantly in some localities in Eastern New York: in Orange Co., it has been mistaken by some fruit-growers for the San José scale, but from their great dissimilarity in appearance, there is hardly an excuse for confounding them.

The figure representing an infested plum branch is from a photograph taken by the Geneva Experiment Station, and employed in illustrating a brief notice of the insect by Prof. S. A. Beach, in *Garden and Forest* for July 18, 1894, from which paper it has been obtained.

In the preceding brief notices of some of our more common scale insects, particular mention of the insecticides available for their destruction and methods of application, have been omitted, as those which will be indicated for use against the San José scale, will be found equally serviceable against each one of them.

THE SAN JOSÉ SCALE

The San José Scale—from the many different fruit trees that it infests, the rapidity of its multiplication through its successive broods during the year, and the short time in which it kills the trees that it attacks—is justly regarded as one of our most pernicious scale-insects. Its character is indicated in the specific name of *perniciosus* given to it by Professor Comstock when first described by him in 1880, in the *Report of the Commissioner of Agriculture* for that year. He has written of it: “It is said to infest all the deciduous fruits grown in California, excepting peach, apricot, and the black Tartarean cherry.* It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable. In other instances I have seen the bark of all of the small limbs completely covered by the scales. I think that it is the most pernicious scale-insect known in this country.”

The Los Angeles (Cal.) Horticultural Commission, in their report for 1893, say of it: “This pest, if not speedily destroyed, will utterly ruin the deciduous fruit interests of this coast. It not only checks the growth of the tree, but it covers the tree literally entirely, and the fruit nearly as much so, and, if left unchecked, the tree is killed in three years’ time.”

INTRODUCTION AND SPREAD

As with the larger number of our more injurious pests, the San José scale is not native to North America. Where it originally occurred is not known. It is frequently found upon plants imported from Japan (Coquillett), and also occurs in Chile and in Australia. It is believed to have been brought into California in or about the year 1870. It first attracted the attention of fruit-growers at San José, in Southern California, in 1873. In 1882 it had extended into all the fruit-growing districts of California, and had entered Oregon and Washington. It is also found in Nevada, but when first observed there is not known. It is reported in one locality in Idaho in 1894 (Aldrich), and as well established at Las Cruces, New Mexico (Cockerell).

* It has since been found on the peach, and apricot.

OCCURRENCE IN EASTERN UNITED STATES

It was quite a surprise when not long ago the discovery was made that this destructive insect had crossed the continent and had made its appearance in the Atlantic States. Its first recognition was by Mr. L. O. Howard, of the Division of Entomology at Washington, in August, 1893. A supposed fungus disease on pear sent from Charlottesville, Va., to the Department of Agriculture and shown to Mr. Howard, was "at the first glance recognized as that scourge of western orchards, the San José scale (*Aspidiotus perniciosus* Comst.)."

INVESTIGATIONS, ETC., BY THE U. S. DEPARTMENT OF AGRICULTURE

During the autumn, two of the assistants of the Entomological Division, Messrs. Schwarz and Coquillett, were sent to Charlottesville, to examine and report upon the infestation. It appeared from their examinations that it was limited in extent, being almost wholly confined to a pear orchard of about a square acre in area, but that it affected pear, peach, plum, apple, currant, rose, quince, gooseberry, and raspberry, and that it had already been present there for several years. It was subsequently learned that, in all probability, it had been introduced on nursery stock purchased from a New Jersey firm. Mr. Hedges, the owner of the orchard, was of the opinion that it had been brought on currant plants purchased in New Jersey eight years previously. Mr. Schwarz reported on the situation of the infested orchard, the plants attacked, other infested places adjoining, habits of the scale, and its observed enemies. Mr. Coquillett reported upon the infested locality, and the conjectural sources of the scale. (*Insect Life*, vi, 1894, pp. 247-254.)

Early in the spring of 1894, through the coöperation of the U. S. Department of Agriculture and the Virginia State Board of Agriculture, Mr. Coquillett, who had conducted very successfully most of the experiments in California for the destruction of scale insects by inclosing the infested trees with tents and fumigating them with hydrocyanic acid gas, was entrusted with the operations for destroying the scale in Charlottesville by the same method — always effective when properly conducted. It appears in his report submitted (*loc. cit.*, pp. 324-326), that 326 trees and shrubs were

subjected to the gas treatment. Examination made a few months thereafter disclosed no living scales.

In Maryland.—In March, 1894, the scale was sent to the Division of Entomology on peach twigs from a large peach orchard in Riverside, Charles Co., Md. It was learned that the scale had been introduced in 1887 and 1888, on peach trees purchased of a New Jersey nursery. Many of them had died, and nearly all of those that remained were found to be thoroughly encrusted with the scale, so that at the time of examination they were being taken up and destroyed. (Other trees to which the scale had spread, had been treated by their owner during the preceding winter, apparently with good results, with the three principal winter washes, viz., strong kerosene emulsion; lime, salt, and sulphur; and resin wash.) A trunk-washing in April with strong kerosene emulsion was successful to the extent of killing 90 per cent of the scales. Several sprayings were made during the summer with different mixtures,—some of them under direction of Mr. Coquillett,—by which most of the scales were killed. At the time of Mr. Howard's report (from which most of these items relating to the eastern presence of the scale have been drawn) in August, it was thought safe to say that the insects would be completely stamped out in this locality by the close of the year.

In Florida.—At the same time of the discovery of the Maryland locality, the scale was also received from De Funiak Springs, Florida. At the request of the fruit-growers of that section of the State, the Department of Agriculture sent Mr. H. G. Hubbard to make examination and report. The insect was practically confined to the peach and plum, but occurred also, in small numbers on Kieffer pears, and on pecan and persimmon. Many thousands of trees were infested, and nearly every orchard within a radius of five or six miles was more or less attacked. Arrangement was made for the Experiment Station of Florida to undertake the work of destroying the scale, by going over all the infested trees in the district with five or six applications of the resin wash. If the weather should prove favorable for the use of the wash, there was reason to believe "that the nuisance will have been abated by the close of the season in Florida, although extermination [from the peculiar conditions of the infested locality] may not be found possible."

Discovered in other States.—In consideration of the discovery that some at least of the above-noticed infestations of this pernicious California scale, were traceable to New Jersey nurseries which were, in all probability, still serving as distributing centers for the distribution of the pest over nearly all the country, a Circular was prepared by Mr. Howard, Chief of the Division of Entomology, U. S. Dept. Agricul., describing and figuring the scale and warning fruit-growers of its exceeding dangerous character, which was distributed in the first week of April (1894) to all Eastern agricultural newspapers and to nearly 12,000 Eastern fruit-growers whose addresses were obtained from the pomologist of the department. This circular,—with its excellent illustrations*, description of its appearance, explanation of its manner of spreading, and the best remedies for it—as might naturally be expected, excited much interest and alarm. Scale insects of many kinds as well as insects belonging to other groups, were sent to the Department, with the inquiry if they were the San José scale.

As the result of the distribution of this Circular, the following additional localities were ascertained:

Neavitt and Chestertown in Maryland; Bartle, Indiana; many points in New Jersey; Atglen and Lewisburg, in S. Eastern and Central Pennsylvania. It was also received from Middletown, Idaho; and from British Columbia.

Referring to the above attacks, Mr. Howard gives encouraging reports: The orchard of 7,000 trees in Atglen, Pa., under direction of Dr. J. B. Smith, Entomologist at Rutgers College, New Jersey, had been treated three times at intervals of ten days, with kerosene emulsion, with absolute success.

At the Lewisburg locality, the few infested pear trees that had been bought from the New Jersey nurseries in 1890, had all been killed but one. Other trees to which the scale had spread were being treated by the owner with every prospect of extermination.

At Bartle, Indiana, two young apple trees from New Jersey were infested. Those were taken up and burned, and no more of the insects were discoverable by careful search. (A second infestation has since been discovered at North Madison—See *Rural New Yorker*, liv, p. 87.)

* I am indebted to the Department for the privilege of introducing them in this paper: see Plates VI and VII.

At Neavitt, Md., a 10-acre orchard of peach trees was badly infested — nearly every tree was languishing from the attack. Many had been taken up and destroyed. Full directions were given for spraying, and the success of the operations will be watched. The source of this infestation could not be definitely ascertained, but it was thought by the owner that the first affected trees had come from a Missouri nurseryman — not from New Jersey.

Chestertown, Md., showed but few infested trees. They had been treated by the owner with thick whale-oil soap of the consistency of molasses, with every prospect of extermination of the scale. The infested trees had been received from New Jersey in 1890. As a summary of the above, Mr. Howard states that the scale had been exterminated (in 1894) in Indiana and Virginia, and the probabilities were strong of a like result before the close of the year, at the other localities named, except in Florida and New Jersey.

It has since come to the knowledge of the Division of Entomology, that the scale has been found abundantly in three new localities in Maryland. It has also been discovered in a locality in Southern Georgia; in an orchard in Southern Ohio; in Newcastle Co., Md.; in Jefferson Co., Indiana; at City Point, Va.; and at Bristol, Pa. In some of these localities the infestation was quite limited, and it is believed to have been exterminated. (L. O. Howard: Further Notes on the San José Scale, in *Insect Life*, vii, 1895, pp. 285, 286.)

THE SAN JOSÉ SCALE IN NEW YORK

During the meeting of the American Association for the Advancement of Science, at Brooklyn, N. Y., in August last — in a paper read by Dr. Smith before the Association of Economic Entomologists on "The San José Scale in New Jersey," it was incidentally stated that an orchard in Columbia County, New York, was known to be badly infested with the scale. The particular orchard was not named, but later, at my request, the information was obtained from Dr. Smith, that Mr. L. L. Morrell of Kinderhook, had not long ago purchased a number of young apple trees (Ben Davis variety) from one of the New Jersey nurseries. Two years later (in 1894), on examination of these trees by one of the owners of the nursery (a relative of Mr. Morrell), they were found to be badly

infested, and advice was given that they should be at once taken up and destroyed. A week or two later it was learned from Mr. Morrell that this had been done, and it was thought that with the destruction of the entire purchase, the scale had been exterminated.

Thinking it important to know whether the measure had been entirely successful, I visited Mr. Morrell early in November, and was met with the unpleasant intelligence that he was fearful that he still had the insect with him, for he had found upon a single pear what he believed to be the scale. It proved to be such,—perhaps a half-dozen of individuals being scattered over its surface.

On examining his orchards, the scale was found abundantly in one of them—a young pear orchard in which a few trees had borne fruit, for the first, the present year. Some of the trees were moderately infested—perhaps a half-dozen scales or less being found upon them; on others the scale was so numerous as to fairly encrust the branches and most of the trunk. It was apparent that the latter were those upon which the insect had been introduced, and from which they had been scattered throughout the orchard by the agency of birds or otherwise to individual trees in various portions of it.

Most, if not all, of the stock of this orchard, had been purchased of the New Jersey nursery two years preceding the planting of that which had been taken up and destroyed—the condition of this having been overlooked at the time. A large portion of the orchard was critically gone over by me, and the trees marked which called for special care in the application of the winter wash recommended, and those which should be at once taken up and burned. The examination of the remainder of the orchard was subsequently made, and a number of infested trees discovered. So determined was Mr. Morrell to rid himself of this pest, that rather than wait for a winter treatment, all of the infested trees, as he has informed me, were taken up and burned: he believed that he did not have a scale remaining in his orchard. If it should prove that in this he has been over-confident, there is every reason to believe that within another year, the scale will be exterminated in this locality.

As the scale occurs also on the leaves—usually in rows along the midrib on the upper side, it was recommended to Mr. Morrell that the leaves from the worst infested trees which at the time of my

visit were lying on the ground beneath or near them, should be raked together and burned, in order to prevent the chance of the scales being carried by the winds over the entire orchard.*

The infested trees were entirely of the d'Anjou variety. In two other orchards of Mr. Morrell of the Kieffer pear, not a scale was found, nor on the apple, cherry, and plum trees that were examined. The infestation was apparently confined to the two purchases made at the New Jersey nursery and had not extended beyond them.

THE SCALE ON LONG ISLAND

In September of last year the scale was discovered in abundance in some of the nurseries on Long Island by Messrs. Sirrine & Lowe, who had been commissioned by the State Agricultural Experiment Station at Geneva for conducting some entomological investigations especially desired on Western Long Island, under an appropriation of \$8,000 made by the Legislature of 1894 to the Station named, "for the purpose of agricultural experiment, investigations, instruction and information, in the Second Judicial department" of the State.

Among the earlier results of their investigations was the discovery of the San José scale in great abundance in some of the nurseries on the Island. The following notice of its first observation was communicated to *Garden and Forest*, of November 7, 1894:

The San José scale was observed first in the market at Jamaica on some Bartlett pears said to have been grown on the Island. The scale was also conspicuous on some fancy varieties of pears exhibited at the Queens County Fair; and by tracing the fruit to its source some of the infested nurseries were located. We have found the scale on Pear, Apple, Peach, and Quince stock in several nurseries.

The nurserymen were unable to give any definite information regarding the length of time that they had had the scale, but it was thought by some of them that it had been with them for the past twenty years. This, under the circumstances, is impossible: They had doubtless mistaken some other scale for it. Nor can anything definite be learned of the source of the infestation. If known to

*Dr. Smith does not believe that the fixed scale can be carried on fallen leaves. He states (*Bulletin 106 New Jersey Agricul. Coll. Exp. Station*, 1895, page 15): "Only such as are affixed to the tree itself have any chance of reproducing their kind. Those that fix to the leaves fall with them, and as these dry or decay the insect dies for want of food before attaining maturity."

them they have been unwilling to communicate the fact. It is stated that the stock that was infested was not grown by them, but was received from other nurseries. It would be of material service in the efforts that are being made for the extermination of the scale in the East if the localities of these "other nurseries" could be learned, but for some unknown reason it is being withheld. This unfortunate reticence is reflecting on all the other nurseries of the State of New York, for it seems to be implied that from some one or more of them the Long Island infested stock was originally received. It is conceded that its source was not the New Jersey nurseries.* The Geneva nurseries have been inspected by Mr. Lowe, with the result, it is inferred, that the scale was not found therein. The Rochester nurseries have been strongly suspected. Mr. W. C. Barry, when consulted, believed them to be entirely free from its presence, and this belief was subsequently carried to approximate certainty by examinations made by Mr. Sirrine, from which it resulted that the reported San José scale at Rochester, when examined at Washington, was found to be *Aspidiotus ancylus* — a closely resembling, but comparatively harmless species.

CONDITION OF THE LONG ISLAND NURSERIES

It would be of interest if the exact condition of the Long Island infestation could be given in this Bulletin. I can state, however, from information received from Mr. Sirrine, under date of March 22d, that he had visited the following nurseries on Long Island: — of Fred Boulon, Sea Cliff; Keene & Foulk, Flushing; Parsons & Sons, Flushing; Isaac Hicks & Sons, Westbury Station; R. P. Jeffery & Sons, Smithville South; P. H. Foster, Babylon; W. C. Wilson, Astoria; Gabriel Marc & Co., Woodside; and the Long Island Nursery Company, Brentwood.

The last six of the nine above-named nurseries were found to be free from the scale. In the worse infested of the three,—as soon as the attention of the proprietors was called to the destructive enemy that they were harboring, a large number of trees were taken up and burned. The remainder were sprayed, according to

*It has since been learned that one of the Long Island nurseries has been receiving stock nearly every year since 1888 from one or the other of the New Jersey nurseries.

directions given by Mr. Serrine, and would be followed by other sprayings in the event of the first not proving to be entirely effectual.

In the other two nurseries, the few trees that had been found to be infested had been destroyed, and it was thought that such further work would be done before the time for shipment, that no infested stock would be sent out from them.

It was probably one of these two, that had been reported as intractable last summer. As represented at the time, the owners were indifferent to the evil pointed out to them that would result from the multiplication of the pest, and indisposed to take any measures against it. When again seen by Mr. Serrine in March, they would give no assurance of adopting the measures deemed necessary for preventing the distribution of their infested stock. The only promise that could be obtained from them was, that "they would treat with gas the stock they sold, providing that they had the time." A promise so broadly qualified could carry no weight with it. Unless a satisfactory understanding can be had with the firm, its name, if furnished to me, will be given in a foot-note, as a protection to purchasers of Long Island stock.*

There is scarcely a doubt but that infested stock has been sent from these nurseries to many places in the State of New York. If the attempt that is being made for the extermination of the scale in the State during the present year is to prove successful, it is of the utmost importance that each locality where possibly infested trees have been delivered within the past five years (dating back to the

*The name of this nursery has since been given me as the Parsons & Sons Company, at Flushing, Long Island. In a letter addressed them on April 8th, the following questions were asked, and the reasons stated why replies were needed: 1. Have you taken steps to learn by application to Mr. Serrine or by other proper means, of the extent of the infestation in your nurseries? 2. Have you taken up and burned the stock that was found to be the worst infested? 3. To what extent and with what results have you sprayed with proper insecticides such other infested stock as it was not thought necessary to wholly destroy? 4. Have you arranged for treating the nursery stock sent out this season with hydrocyanic acid gas, according to the approved directions published and accessible to you? 5. Have you sent out any nursery stock this year which may have been infested without having been subjected to the gas treatment?

In the answer returned by the Parsons & Sons Company to the above-mentioned letter, the only reply to the questions proposed is that found in the following—

probable establishment of the scale on Long Island) should be ascertained, and carefully inspected as soon as possible. Request was accordingly made of the proprietors of these infested nurseries, that they would furnish the State Entomologist with a list of their New York sales from and including the year 1890 to the present. One of the firms promptly complied with the request, so far as it could be done without involving excessive labor, and sent to this office extended lists, at the same time offering to open their books for further examination and transcription by any one who might be commissioned for the purpose.

It is due to this firm — Keene & Foulk, Bloodgood Nursery, Flushing, L. I., that they be specially mentioned, and commended for the earnest manner in which they are working for the extermination of the scale in their nursery. They have asked for suggestions and directions and have promptly and faithfully carried them out — not only in burning and spraying, but also in arranging, under the best approved method, for the fumigation by the hydrocyanic acid gas treatment of all the stock that they send out this season; the latter should ensure the destruction of any scattered individual scales that may have been overlooked. They will also, upon request, replace at half-price, all such infested stock that has been received from their nursery in former years before its condition was known.

In consideration of what they have done and are doing for the protection of their customers (and at the same time, of their own interests), it is believed that orders may be more safely sent to them

prefaced by, "We only knew last fall of the San José scale:" "He [Mr. Sirrine] has informed us now of the plants infected, and we shall take them up and burn them as soon as possible. It is our intention to destroy rather than to spray. In the plants now sending out we have not noticed any infected: it would be impossible in any event to subject to the gas treatment while in the rush of sending off trees."

Is it possible — as may be inferred from the above, that up to the middle of April, absolutely *nothing* has been done by this company toward freeing their nurseries from this dangerous insect?

In the absence of present legislation authorizing entrance upon private grounds for the destruction of the San José scale, it only remains for purchasers of trees, shrubs, etc., subject to its attack, to protect themselves so far as they may, by withholding orders from localities known to be infested and where no efficient measures have been and are being taken for its extermination.

than to other nurseries where the scale may be reasonably looked for — where no thorough inspection has been made — where it may exist without having been detected, and where no gas fumigation, as a safeguard against such a contingency, is practised.

From the two other known infested nurseries on Long Island, no notice has been taken of the request for lists of New York sales of possibly infested stock, sent them under date of Feb. 15, 1894.*

THE SAN JOSÉ SCALE IN NEW JERSEY

Nearly all of the infestation in the Atlantic and adjoining States having been clearly traceable to the sale — without knowledge or suspicion of their dangerous condition — of infested trees by two

*The following letter was addressed to each of three nursery firms above referred to:

Gentlemen: — Will you be kind enough to favor me with a list of the addresses of all the persons in the State of New York to whom you have made sales during the last five years (1890-1894) of nursery stock which might possibly have been infested with the San José scale which you have in your nurseries.

We are expecting to get a bill through our present Legislature by means of which we shall be able to have each locality into which infested stock may have been introduced, examined by an expert, and such measures taken as give promise of exterminating the scale in our State during the present year.

If you will furnish me with the list requested, it will aid much in this undertaking.

You will also see that in consideration of the serious character of this pest and the danger of its introduction into new localities, that not until we are able to report as free from infestation, all the nurseries of the State, especially those on Long Island which have been widely published (without names), will there be a willingness on the part of fruit-growers to order stock from nurseries actually having or suspected of having, the dreaded San José scale.

One of the largest nurseries in New Jersey which had made wide distribution of the scale, has sent me a list such as I ask of you, and is doing everything in its power to prevent distribution of any infested stock.

I had asked Mr. Sirrine to procure such a list for me, but I have thought it better to make a personal request.

We must, if possible, in the interests of both fruit grower and nurseries, as soon as it can be done, exterminate the scale from our State.

I am very desirous of being able to say in the Bulletin which is nearly ready for publication, that I have reliable assurance that no further distribution of the scale will be made from New York nurseries. The name of your nursery will not appear in it.

Very truly yours,

nurserymen in New Jersey, there will naturally be a deep anxiety to learn what has been done in New Jersey toward the prevention of further distribution of the dangerous pest, through purchases that may have been made in 1894 or to be made hereafter.

From a Bulletin entitled "The San José Scale in New Jersey" (*Bulletin 106 of the New Jersey Agricultural College Experiment Station*), prepared by Dr. J. B. Smith, Entomologist of the Station, and issued in January, 1895, we learn that the introduction of the scale in New Jersey occurred either in 1886 or 1887, upon a "Kelsey" plum ordered by the two nurseries under the representation of its being curculio proof, from the San José district, California. It is also known that some Idaho pear stock brought from nurseries on the Pacific Coast were also infested.

As soon as Dr. Smith became aware (in April 1894) of the existence of the scale in the State, he at once, with his accustomed energy, entered upon the task of finding the nurseries from which the infested stock had been sent, and so far as possible, the other infested localities within the limits of the State. Two large and well-known nurseries, widely separated, were soon located, and these, so far as could be ascertained, were the only distributing centers. The owners, upon being informed of the dangerous character of the pest that they were harboring, and the effect that it might have upon their business in the future, immediately took active steps for stamping out the insect upon their bearing trees, upon which it mainly occurred, and promised to prevent, through fumigation or otherwise, further shipment of infested stock. In one of the nurseries several blocks of young stock were at once torn up and burned.

The scale had been distributed from these nurseries to a number of orchards throughout the State (nearly one hundred were known to Dr. Smith), but nowhere in sufficient numbers to have spread from the orchard in which it was at first introduced. In all of these, it is believed that measures will be taken by their owners for the prevention of further spread, and toward extermination.

The work will be carefully watched, and, with our knowledge of the zeal, persistence, and ability shown by Dr. Smith in all of his operations against the noxious insects that are so unfortunate as to intrude within his jurisdiction, we have every assurance that, if extermination is possible, it will be speedily effected.

THE TWO INFESTED NEW JERSEY NURSERIES

The interest felt among the fruit-growers of New York in the New Jersey nurseries, from which large purchases have been made each year, has been already mentioned, and will warrant a more particular reference to their present condition. Quite a satisfactory account of one, and an encouraging account of the other, can be given, based on letters from Dr. Smith, from correspondence with the proprietors of the nurseries at the suggestion of Dr. Smith, and from statements made in a recent number of the Rural New Yorker (of March 9th). The article in the R. N. Y., written by a gentleman connected with that journal, after a visit to Little Silver, N. J., to examine into charges that had been "publicly made that the Lovett Company have done practically nothing to exterminate the scale," publishes the names of "the two nurseries as those of Wm. Parry and The Lovett Company." There can, therefore, be no impropriety in the mention of their names in this Bulletin.

The Wm. Parry Nurseries.—The nurseries of Wm. Parry, are gladly mentioned, for the same reason given for making public the name of the nursery of Keene & Foulk, of Long Island. Unqualified praise is due Mr. Parry for his strenuous efforts for the extermination of the scale in the widely-known and far-famed "Pomona Nurseries," at Parry, and the aid so freely extended, in the endeavors being made, for its extermination wherever his extended sales may have borne it.* Promptly upon receiving a request for a list of New York sales which may have distributed the scale throughout the State, the desired list, embracing several hundreds of names, scattered through nearly every county, was sent to me, without any suggestion of compensation for the labor which it necessitated.

The expression of the confidence with which it is believed, orders could be sent at the present time to the Bloodgood Nursery, would apply in, at least, equal force to the Pomona Nurseries, where operations against the scale have been conducted largely under the direction and supervision of the New Jersey State Entomologist, Dr. J. B. Smith.

The Lovett Company Nurseries.—Of the condition at the Lovett Company Nurseries, the following is reported in the Rural

* We are indebted to Mr. Parry for the detection of the scale at Kinderhook, N. Y., in the summer of 1894, as noticed on page 279.

New Yorker, *loc. cit.* Some bearing trees upon which the scale had been located last autumn by Prof. Smith, had meantime been cut down and destroyed. Satisfactory apparatus for treating the infested nursery stock was found. Upon the scale being pointed out by Prof. Smith on a considerable number of young pear and apple trees that were heeled in, and in patches here and there in rows, they were cut down as fast as found, and, finally, Mr. Lovett agreed to chop out and burn the entire block. The larger part of the nursery stock had been heeled in, after having been treated with gas. The scales upon them, according to Prof. Smith, had been "practically killed," and, if treated again before being sent out, he would consider them safe. Mr. Lovett would "guarantee to destroy every tree where Prof. Smith had found the scale, and, also, to give all these trees a second treatment with gas." The Rural New Yorker concludes its account thus: "If this is done, there will be little danger of importing the scale from this nursery. This statement refers simply to the trees now in the nursery. What has already been sent out we do not know."

Much may be inferred, and seems to be implied, in the short sentence last quoted. It is here that the Lovett Company has chosen to place itself in a position exposing it to just and severe criticism. It virtually declines to do anything toward undoing the evil which it has perpetrated — for the most part unwittingly, we believe — in the distribution of infested stock in the State of New York.

Request was made of them from this office in November, 1894, for a list of sales such as Mr. Parry had sent me — stating fully its character. After several months' delay, reply was made (Feb. 4th), declining the request upon the ground of the immense labor that it would involve, but offering to place their order books at the disposal of any persons who might be sent for their examination. As this plan did not seem feasible to Dr. Smith — after further correspondence with him, he was asked to procure, if possible, the desired list from the Company for me, for which the expenses incurred would be paid. Dr. Smith wrote them, urging compliance with my request. The letter received from the Company in answer contained the following proposition: "If he [Prof. Lintner] will send us, or you either, a remittance of \$250, we will attempt to make the examination desired. * * * But we want a clear understand-

ing before we begin as to the settlement of cost of sending the list he requires." No comment on this modest proposal is needed!

The course taken by this firm has been so unaccountably strange in other respects as to expose them to suspicions which possibly may do them injustice. On the authority of Dr. Smith, the statement is made, that during last autumn [in September] in a visit of observation made them, he found that practically all of the trees in their nursery blocks were infested by the San José scale. He notified them of this fact at the time, and showed to both the President and Secretary of the company who were with him, the infested trees and the scales.

Under date of December 28th following, the Lovett Company, writing to the Director of the Ohio Agricultural Experiment Station in relation to some infested apple trees that had been sent by them to Clermont county, Ohio in 1890 — disavow all knowledge of the scale. They say:—"We would like very much indeed to have some branches from the trees referred to for examination ourselves. We have made a critical examination of our trees here in the nursery and also fruiting trees, and can find no trace whatever upon any of them of the San José scale or other scale. Having read reports upon the San José scale, we are confident that we could detect this insect if it existed upon our trees." (*Bulletin* 56, Dec. 1894, *Ohio Agr. Exper. St.*, p. 83.)

It is fortunate that since this letter was written, such pressure has been brought to bear upon the firm that it has taken the effective measures for its destruction reported in the *Rural New Yorker* cited, and in letters received from Dr. Smith.

As no aid is to be obtained from the company toward the examination of stock that it may have sent into the State of New York, request is herewith made of each person who within the last five years has received from the nurseries of the Lovett Company, Little Silver, N. J., fruit trees and ornamental shrubs, or other plants on which the scale is known to feed, that he will send his name to the State Entomologist, at Albany, with mention of the fact. If the arrangement proposed can be carried into effect, examinations will be made by competent persons of all such stock for the detection of the scale if present.

THE SAN JOSÉ SCALE IN OHIO

It is learned from Prof. F. M. Webster, that an infested locality in Clermont County, Ohio had come to his notice in December of 1894. The scale had probably been introduced in 1891 on apple trees purchased of the Lovett Company, of Little Silver, N. J. Prof. Webster reports: "The orchard comprised about 600 trees, probably one-third of which were more or less infested — twenty-five at least so badly as to preclude all possibility of saving them, and at least double that number that could only be utilized by cutting off the trunks at a short distance above the ground and grafting them, first disinfecting the stumps. The pest had been noticed the previous year. * * * A smaller orchard set at the same time and with trees from the same nursery, was found infested to a much less extent, though the scales were badly scattered through the orchard. * * * The owners of these two orchards will take this scale in hand and stamp out the pest before it gets a stronger foothold or becomes more widely spread." (*Bull. 56 Ohio Agr. Exper. St.*, December, 1894.)

DESCRIPTION OF THE SCALE

The female scale, greatly enlarged is shown at Fig. 4 of Plate V and at *b* in Fig. 2 of Plate VI. It is flat, almost circular in outline, dark mottled with gray in color, with a small elevated spot at or near its center which is black or yellowish; it measures about one-sixteenth of an inch in diameter, but under some favoring conditions may attain a size of one-eighth of an inch; in its original description it is given as 0.08 of an inch.

Professor Comstock described the male scale as "black, somewhat elongated when fully formed. The larval skin is covered with secretion; its position is marked by a single nipple-like prominence which is between the center and the anterior margin of the scale. The scale of the male is more abundant than that of the female." It is often oval in shape, and of a smaller size than the female. It is represented at 5 in Plate V.

When occurring upon the bark of the twigs or leaves and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass: see Fig. 1 of Plate VI. The general appearance that they

present is of a grayish, very slightly roughened scurfy deposit. The natural rich reddish color of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they then have every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft, yellow insects beneath, and this will at once indicate to one who is not familiar with their appearance, the existence of healthy living scales on the trees. (*Circular No. 3, 2d series, U. S. Dept. Agriculture, Washington, 1893.*)

As before stated, the scale is also found upon the fruit. When present, in large numbers to the extent of covering the entire surface, it interferes seriously with the proper development of the fruit, causes it to crack, often to fall from the tree, or when it remains thereon, renders it unmarketable. It is a conspicuous object from the little depression which it causes (at least late in the season) and usually a well-defined purplish ring with which each scale is surrounded of a diameter considerably larger than that of the scale (see Figure 3 on Plate V and Figure 2 on Plate VI).

THE INSECT

The male.—As previously stated, the male only, becomes winged. It is shown greatly enlarged in Fig. 3 of Plate VII—its natural size being indicated by the crossed lines within the circle beside it. Examined under a high magnifying power its wings are seen to be transparent, each with two delicate veins only. It has a well-defined thorax and a rather large head with two large eyes. Its body is of a light amber color with dark brownish markings, and terminates in a slender “stylet” nearly as long as the body, which is the external organ of reproduction. The antennæ are long and conspicuous, ten-jointed, eight of which are hairy.

The above description of the male will be of no particular interest to others than the entomological student, as but few fruit-growers will ever see it in nature, as it is difficult to obtain and needs a good microscope for its inspection.

The female.—Soon after the leafing of the tree in the spring, when the young have crawled out from beneath the scales, close examination of an infested twig will show them as yellowish objects,

scarcely more than points to the unaided eye moving over the bark (Matthew Cooke has given their size as one-seventy-fifth of an inch). They are of an oval form, with the normal number of legs pertaining to insects — three pairs — and a pair of antennæ. In Fig. 1 of Plate VII, giving an enlarged view of the insect from the under side, its curious long hair-like beak or proboscis which serves it for feeding and for fastening itself to the bark or leaf or fruit, is shown as curled up between the legs.

The mature female can only be seen by taking her from beneath the scale at the proper time. She then appears in a very different form from that when moving over the bark. In a subsequent molting she had lost her legs and antennæ, retaining only for her need her long and delicate proboscis consisting of four hair-like bristles within a two-jointed sheath. Fig. 2 of same Plate represents this stage of the insect, enlarged from the hair-line at the right-hand side. It is shown from the underside as seen with its transparency in nature, with a number of its young within,—this species, unlike most of the scale-insects, which produce eggs—bringing forth its young alive. Of the several segments into which the body is divided, as indicated in the figure, the last one bears groups of spinnerets, anal and vaginal openings, and upon its border, lobes, incisions, and spines (some of which are shown in enlargement at *d*): from the location, number, and form of these, important and reliable characters are drawn for the separation of the species, which may not be found in the study of the external scale alone, where they closely resemble one another.

ITS LIFE-HISTORY

Most of the Coccidæ are oviparous—that is, they deposit eggs underneath the scale, from which the young are soon thereafter hatched. A few are known to be viviparous, i. e., bringing forth living young, as *Aspidiotus tenebricosus* occurring on maple, and a few species of the genus *Lecanium*.* It would seem that the San José scale, *Aspidiotus perniciosus* is both oviparous and viviparous, for while generally regarded as giving out its young alive (the young shown within the body of the parent in Fig. 2 of

* As *Lecanium hesperidum*, *L. platycerii*, *L. tulipiferae*, and two unnamed species on the red bay and on Acacia.—Riley, in *Proc. Ent. Soc. Wash.*, III, 1894, pp. 67, 69.

Plate VII), it is also recorded as producing eggs. Dr. Riley has stated of it (*loc. cit.*)—"specimens examined in December, 1879, showed that the mature females were hibernating, and that with some of them were found a few eggs and recently hatched larvæ:" on the authority of Professor Comstock (*Rept. Commis. Agricul.* for 1880, p. 305), "the eggs are white:" Matthew Cooke has written (*Inj. Ins. Orchard, Vineyard, etc.*, 1883, p. 62)—"each female produces from thirty-five to fifty eggs:" W. G. Klee, State Inspector of Fruit Pests in California, states (*Bien. Rept. St. Bd. Horticul. Cal.* for 1885 and 1886, page 373)—"eggs, thirty to fifty produced by each female; color yellow; form ovate:" Mr. C. H. T. Townsend, formerly of the New Mexico Agricultural Experiment Station, states of the eggs—"According to Comstock, the eggs are white; but according to my own observation, they turn to an orange-yellow color in the spring. They hatch here about the first or second week in May" (*Bulletin No. 7 New Mexico Agr. Exper. St.*, June, 1892, p. 7). Other writers have also mentioned the eggs. As opposed to this, however,—in colonies of the scale carried over on potted pear trees in the Insectary of the Entomological Division at Washington during the winter of 1893-4, although watched with care and subjected to daily observation,—in no instance were eggs seen (*Insect Life*, vii, p. 287).

Early in June, ordinarily, in New York and New Jersey, the young escape from underneath the scale, and for a short time may be seen traveling actively over the branches, when they fasten themselves to the bark and commence to secrete a scale. They are not all given out at the same time, even the members of the same family. How long the hibernating female continues to reproduce, is not known. It is thought by Dr. Smith that it may extend over the greater part of the summer, and until "their grand-daughters are already full-grown with nearly full-grown progeny: there may be, therefore, upon a plant at one time, young born of as many as three or even four distinct generations." Certain it is that examination of an infested orchard will show the presence of the young traveling insects at any one time from early June until nearly the last of autumn. On some pieces of twigs cut in Mr. Morrell's orchard on November 1st, the little yellow young were seen in motion two days thereafter in my office. It is probable that the

young will not survive on a twig cut from the tree, for more than four or five days.

Observations made on isolated individuals at Washington showed that "the newly-hatched larvæ after crawling about for a few hours, settle down and commence at once to form a scale, which is white and fibrous. In two days the insect becomes invisible, being covered with a pale, grayish-yellow shield with a projecting white nipple at the center. * * * * * Twelve days after hatching, the first skin is cast. * * * * * In twenty to twenty-one days after hatching, the females cast their second skin. At 24 days the males begin to issue. * * * * * At 30 days the females are about full grown, and embryonic young can be seen within their bodies; and at from 33 to 40 days the larvæ begin to make their appearance." For additional observations on the development of other broods, see Howard, *Insect Life*, vii, pp. 288, 289.

From the first brood hatching early in June, a second is undoubtedly disclosed in July. How many follow, has not been ascertained. Matthew Cooke has placed the number during the season, at three,—the first in June, the second in July, and the third in October; but it would seem that the high temperature of summer could hardly fail of developing at least one additional brood intermediate to those of July and October. Four broods were developed at Washington from over-wintered females, and it was thought that there were ordinarily five. They soon became so inextricably mixed that the only importance that could attach to a determination of their number, would be as indicating the rapidity of increase of the insect in different localities and under different seasonal conditions.

The females continue to feed until prevented by the dormancy of the tree in the late autumn. It is thought that most of them pass the winter in about a half-grown stage, and resume their feeding in early spring, as soon as practicable for their entrance upon active life, in June as above stated.

ITS FOOD-PLANTS

In addition to the food-plants of the San José scale that have been mentioned in the preceding pages, several others have

recently been reported to me by Mr. Sirrine, as observed by him on Long Island.

The following is the list as it now stands. It will doubtless be largely extended by future observations :

<i>Tiliaceæ</i>	<i>Saxifragacæ</i>
Linden (<i>Tilia</i>).	Gooseberry.
	Currant.
<i>Celastraceæ</i>	Flowering Currant.
Euonymus.	
<i>Leguminosæ</i>	<i>Ebenaceæ</i>
Acacia.	Persimmon (<i>Diospyros</i>).
<i>Rosaceæ</i>	<i>Urticacæ</i>
Almond.	Elm.
Peach.	Osage Orange
Apricot.	
Plum.	<i>Juglandaceæ</i>
Cherry.	English Walnut.
Spiræa.	Pecan Nut.
Raspberry.	
Rose.	<i>Betulaceæ</i>
Hawthorn (<i>Crataegus</i>).	Alder? (<i>Alnus</i>).
Cotoneaster.	
Pear.	<i>Salicaceæ</i>
Apple.	Weeping Willow.
Quince.	Laurel-leaved Willow (from
Flowering Quince.	Asia).

It will be seen from the above that the scale is recorded as occurring on plants in ten of the Orders, although one-half of the food-plants named belong to the Order of *Rosaceæ*.

SPREAD OF THE INSECT

The natural spread of this scale is not a rapid one. As the female is unprovided with wings, and is unable to change its position after having become fixed and throughout its entire period of reproduction, the insect can only pass from one tree to another during the few hours that it continues in its active larval stage. Although a rather rapid traveler its range of locomotion would hardly ever carry it to neighboring trees in an orchard, unless the branches should

interlock, in which case every facility is afforded it for spreading the infestation,—almost equal to that existing in nurseries where the young trees are grown so closely together as to form compact masses.

Carried by birds, etc.—It has been found that the young insect may be distributed through the agency of other insects and of birds. When abounding on a tree to the extent that much of the bark is already occupied by the scales, they apparently show a disposition to leave the tree and fasten upon any visiting insect or to the legs of birds. If this is instinctive or in accordance with a purpose, they will leave their hosts as soon as transported to a favorable place for the establishment of a new colony. It is stated that several of the young have been seen upon the wing-covers of a single lady-bird,—that they are often found on ants, and that they show a preference for insects of dark color.

Distribution in Nursery Stock.—The ease with which many of our most serious insect pests may be widely distributed through sales of nursery stock, has been brought to notice so frequently in recent years by studies made of the means by which injurious insects have suddenly made their appearance in new localities, that our economic entomologists have deemed it their duty from time to time to warn fruit-growers of the danger to which they are exposed, and to press upon them the great importance of a thorough inspection of all the nursery stock purchased by them. Each of the recent occurrences of the San José scale in the Eastern States, has been traced directly, or with a strong probability, to nursery infestation as its source. Of course, the danger of such introduction is the greater when the insect is so inconspicuous as is this scale, or when it is entirely hidden within its burrows in the branches or trunk, as in the case of the flat-headed pear tree borer, *Agribus sinuatus* Oliv., lately discovered in New Jersey orchards by Dr. Smith, and by him traced to a New Jersey nursery which it was supposed had imported it from Europe about ten years ago.

PROTECTION FROM INFESTED STOCK

In view of this danger, the following suggestion made by Dr. Smith (*Entomological News*, v, p. 311) is both timely and important: "No farmer should set out a tree until he has examined it closely and made certain that no scale-insects infest any portion of

it. He should also wash at least the trunk and larger branches with a kerosene emulsion, diluted by no more than five parts of water; and he should, finally, trim back to the smallest possible amount of wood, burning or otherwise destroying all the cuttings," thereby facilitating the growth of the tree, and disposing of the eggs of the Aphides or plant-lice and of mites occurring on the smaller twigs.

Dr. Smith also offers the following:—"Purchasers of nursery stock could insist on a written guarantee with each lot of stock purchased, that they are clean and free from insect pests, and had not been, in the nursery, affected by any plant disease, nor grown in the vicinity of diseased trees".

It is not probable that the New Jersey or Long Island nurserymen would give such a guarantee, nor does it seem that they could safely do so. Were they, one and all, skilled entomologists they might, even then, with reason, decline to commit themselves so broadly,—covering insects of all kinds, both exposed to view and hidden from the eye. But for the present, at least, while the scale infestation of these localities is so generally known, some assurance of protection will be demanded by all to whom the knowledge has come, before further orders are sent to the nurseries involved.

The following form of certificate is offered to the consideration of purchasers and nurserymen, in the belief that it would prove equally beneficial to each party. Without it, or something to the same effect, there is reason to believe, from action about to be taken in another State, that some of the unfortunate nurseries may suffer for a time from a "boycott". Let it be understood—there is no disposition on the part of any entomologist to magnify the danger to important interests from this newly introduced pest, but simply to accept it at its full magnitude:—

I do hereby certify that the stock sent out herewith has been examined by a competent entomologist, and has been pronounced by him, to the best of his knowledge and belief, to be free from living San José scales (*Aspidiotus perniciosus*); and in the event of its being shown that the stock now sent has carried with it the living insects, I do hereby agree to replace it free of cost with uninfested stock.

PROPOSED LEGISLATION

No legislation has been had in the State of New York against insect pests. Laws of this character, more or less broad and stringent, have

been passed in ten of the States, viz., California, Colorado, Idaho, Kansas, Massachusetts, Minnesota, Missouri, Nebraska, Oregon, and Washington. A compilation of these Laws, which will be found convenient for examination and as aids to future legislation, has recently been made in a pamphlet of 46 pages by Mr. L. O. Howard, and issued as *Bulletin No. 33 of the U. S. Department of Agriculture — Division of Entomology*. California, it appears, has taken the lead in resorting to legislation, moved thereto by the urgency of preventing the introduction of species known to be destructive to fruit culture in other parts of the country and from the Old World.

Although the State of New York is subjected each year to losses from insect injuries which would aggregate in amount to several millions of dollars — a large proportion of which is preventable, — no effort has hitherto been made toward the removal of so onerous a burden through a resort to legislative aid. An investigation of the insect pests of the State which was commenced forty years ago and continued, with a short interval, up to the present, has given to the people of the State details of the life-histories and habits of all of our more noxious insects, accompanied with methods for their control. These studies are accessible in State reports to all who may desire to consult them. Their recommendations are conceded to be of great value, and if the information they contain be utilized to the extent that it should be, the occasion will seldom arise when aid from legislation is needed.

There may be, however, insect infestation in some other State or country of such a pronounced dangerous character, that its introduction should be guarded against by quarantine laws. Or, an insect may have multiplied to such an extent that its control is entirely beyond individual effort, as in the case of the gypsy moth in Massachusetts. Again, a newly introduced insect pest, known only in a single locality but threatening an almost unlimited range, may call for its extermination while the task is simple and inexpensive.* Still another instance, is that of the presence of the San José scale in the State of New York. There is reason to fear that it has been sent in every county of the State. In how many orchards it has found place can not be known, with-

* Such an opportunity was lost when the pear-midge was confined to a few orchards in the town of Meriden, Conn.

out special examination of suspected localities by a person competent to identify it. Its dangerous character demands its extermination if it can be accomplished. Although it has had a foothold in the State for, probably, five years or more, it is believed that its extermination is practicable if the proper effort can be made at once, under the provisions of a bill which has been drawn up and introduced in the present Legislature — reading as follows:

AN ACT to provide for the Extermination of the San José Scale in the State of New York.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

SECTION 1. Whenever the state entomologist may have knowledge of the existence of the San José scale, or has reason to believe in the probability of its existence in any locality within the State of New York on any trees, plants, vines, or fruit, he shall notify the commissioner of agriculture, who shall thereupon appoint one or more experts who shall be sufficiently familiar with the scale to be able to recognize it, for the prompt inspection of the infested or suspected locality.

§ 2. Such agent shall make thorough inspection of the locality named, and if the existence of the scale is found therein, he shall notify the owner or owners of the orchard, nursery, or grounds in which the insect is found, of its existence therein, and serve a notice containing a statement of all the facts found to exist, upon the owner or owners, with an order that within ten days they shall take such measures as have been proven to be effectual in the destruction of the scale and for prevention of its further distribution, and to continue them until its extermination has been effected.

§ 3. If the owner or owners shall refuse to comply with the order of the agent, as above stated, the agent shall be charged with its execution, and for this purpose, shall employ all necessary assistance; and such agent or his employes may enter upon any or all premises within the town or city for the purpose of the speedy extermination of the scale. Such agent shall be entitled to compensation for his services under this act at the rate of five dollars for each full day spent by him in the discharge of his duties, and the necessary disbursements paid or incurred by him therein.

§ 4. The sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of the state treasury to carry out the provisions of this act.

§ 5. This act shall take effect immediately.

REMEDIES

There is no difficulty in killing this insect at any time and in any form of its existence, if the proper remedies are used and properly

applied: but if entire success is demanded—that is, if all of the insects infesting an orchard are to be destroyed, which means extermination,—so far as our present knowledge extends, it can only be accomplished in the winter season. During the many years of its existence in California the experiments there conducted, showed that several of the insecticidal applications tested, were entirely effective—particularly some of the “winter washes” of which the formulas have been frequently published. When it became necessary to contend with the insect in its eastern invasion, it was naturally supposed that the Californian remedies would be equally effective here, but experiments with them proved that they only sufficed to destroy a certain percentage of the hibernating form; and even when used in double strength, a large proportion of the scales was not destroyed. These unexpected results may probably be accounted for by a more perfect dormancy of the insects in the East than in California.

Winter washes.—The experiments that have been conducted under the direction of L. O. Howard, Chief of the Entomological Bureau at Washington, during the past year (1894), have been so varied and apparently so thorough that it would seem that the results attained might be accepted, without further experimentation, for future guidance in our operations against this scale. During the latter part of the year, twenty-nine different washes were tested by experienced entomologists from the Bureau, upon badly infested trees in Charles county, Maryland. In summing up these results, Mr. Howard has stated: “The only perfect results which have been reached have come from the application of two pounds or more of commercial whale-oil soap to a gallon of water, and from the application of a resin wash of six times the normal summer strength. The effects following the application of these washes leave nothing to be desired. In all cases the most careful search over the sprayed trees has failed to show a single living scale.”

Unfortunately, both of the above-named washes are somewhat expensive, as the lowest price at which the whale-oil soap can be purchased is four cents the pound by the barrel, making the wash to cost eight cents per gallon. The resin wash is still more expensive. When large orchards are to be treated, the cost is quite an item, but the intelligent fruit-grower will not hesitate when con-

vinced that the choice lies between the expense of the wash and the loss of the trees.

The above are known as "winter washes," since they may only be used without serious injury to the tree during its winter dormancy. Later, it would not be safe to apply them unless in a considerably diluted form, when they would only suffice to destroy a portion of the scales.

Home-made whale-oil soap.—For those who would prefer making the soap for themselves, at a less cost than if purchased by the small quantity in market, Mr. Howard has given the following formula:—Potash lye, one pound; fish oil, three pints; soft water, two gallons; dissolve the lye in water and add the oil on bringing the mixture to a boil; boil for about two hours and then add sufficient water to make up for the evaporation. This will make about twenty pounds of soft soap—equivalent to about five pounds of the hard.

The winter resin wash.—The composition and proportions given for this, are as follows:—Resin, 120 pounds; caustic soda, 30 pounds; fish oil, 15 pints; water sufficient to make 100 gallons. The resin and soda are broken up and, together with the fish oil are placed in a large kettle, sufficient water being added to cover them. The whole is then boiled for several hours, or "until the compound will mix properly in water without breaking up into yellowish flakes." (*Insect Life*, vii, p. 293).

Potash wash.—Dr. Smith, in his experiments with the scale in New Jersey, has tested to his entire satisfaction the efficacy of a saturated solution of crude or commercial potash, i. e., potash in a sufficient quantity of water to dissolve it, to be used upon trees during their dormancy in the winter season, only. It may be applied either by means of a cloth or stiff brush, or by thorough spraying. The potash eats into or corrodes the scales and kills a large proportion of the insects beneath them. A month later, by which time the scales will have become riddled or loosened, it should be followed with kerosene emulsion made after the usual formula and diluted to a strength of one part to five parts of water. If these applications are thoroughly made,—according to Dr. Smith, "not a single insect need escape."

Before using any of the above washes, it is recommended to cut

back as freely as may be properly done, the infested trees, and burn the cuttings, as a large part of the scales are to be found on the terminal twigs.

Summer washes.—Experiments thus far made with applications that may be safely used during the summer, have failed to give a wash that will destroy all the scales—a small percentage will escape. The two that have given the best results are the summer resin wash and an ordinary diluted kerosene emulsion. With either of these, “by three applications at intervals through the summer, the insects may be kept from increasing to any serious extent.” The unattached insects and those in which the scale is in its incipency will readily be killed, and if it were possible to reach all of them the entire destruction of the insect would be effected. But this is impracticable. The young are hatching continually during nearly five months of the year, and are to be found at any time during this period in their active stage upon the tree. The number of sprayings that would be required to reach the young before they are protected by their scale, would render this method altogether too laborious and costly to depend upon it for extermination.

Gas treatment.—The treatment of infested trees with hydrocyanic acid gas, generated within a canvas tent made air-tight through the application of boiled linseed oil, and fastened closely down over the tree to be treated, has been extensively used in California and with entire success against some of the scale-insects of the Western Coast. The cost of the tents and the labor involved in their management, render it altogether too expensive for general use; and further,—although it has been hitherto claimed that the gas applied in this manner was absolutely fatal to all animal life, yet, late experiments appear to show that it may not be entirely depended upon for the complete destruction of the San José scale when infesting orchards. According to Mr. Howard, an orchard in Charlottesville, Va., which had been treated with the gas in March last, under the skilled supervision of Mr. Coquillett,—although “the operation was as thorough as it could be made, a few of the insects survived the treatment, as was shown by the receipt of living specimens late in the fall from Dr. Hedges.” (*Insect Life*, vii, p. 286).*

* Mr. Howard has since made personal examination of this orchard, and has found the gas treatment inefficacious. The trees are again badly infested, while one result of the fumigating has been to seriously injure the trees by causing the blackening and cracking of the bark.

Treatment of Nursery Stock.—It is believed that the hydrocyanic acid gas treatment is reliable for disinfesting nursery stock of infested nurseries previous to its distribution. Of course, all such stock found to have the scale in abundance, should be promptly taken up and burned, but where the scale is sparsely present or even where there is barely a suspicion of its presence, it should, before shipment be subjected to the gas fumigation. This is now being done in New Jersey and Long Island nurseries—in some of them at least, and should be made a condition upon which any further orders may be given or stock received from either of the infested districts or others that may hereafter be discovered.

The manner of treatment is the following: An air-tight box is made of suitable size for the reception of as much stock as may be conveniently treated at one time. The stock is placed therein and subjected for an hour to the gas generated in it by the combination of three ounces of water, a little more than one fluid ounce of commercial sulphuric acid, and one ounce of 60 per cent cyanide of potassium, to be placed in a glazed earthenware vessel of the capacity of at least a gallon, in the order above named: these amounts are for 150 cubic feet of space. It should be remembered that this gas should not be breathed as it is exceedingly poisonous.

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The following references to publications upon *Aspidiotus perniciosus* are given as an aid to those who may wish to learn more minutely of the life-history and habits of the insect, or for information upon topics which have been omitted from this Bulletin in order not to extend it to an undue length, as for example: the parasites of the insect (see *Insect Life*, vii, pp. 289-292); the possibility of the limitation of its multiplication in its northeastern range to certain portions of the State of New York and the Eastern States (*id.*, p. 292); its possible introduction through infested Californian fruit (see *Bull. 106 New Jersey Agr. Coll. Exper. St.*, p. 17, and *Insect Life*, vii, p. 167); the varieties of plums and pears more liable to its attack (*Bull. 106—ante*, p. 16); and its natural enemies (*id.*, p. 16).

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SIRRIE: in *Gard.-Forest*, vii, 1894, p. 449 (on Long Island).

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EXPLANATION OF PLATE I.

- Fig. 1.**—The apple-tree bark-louse, *Mytilaspis pomorum* (Bouché), on apple bark. (After Comstock.)
- Fig. 2.**—The scurfy bark-louse, *Chionaspis furfurus* (Fitch): *a*, the female scales, and *b*, the male scales, in natural size on twigs; *c*, the female scale, enlarged; *d*, the male scale, enlarged. (From the Division of Entomology, U. S. Dept. Agr. at Washington.)
- Fig. 3.**—The scurfy bark-louse: [*a*], the male; *c*, the young larva; *f*, the male pupa; *g*, the female, from beneath—all enlarged; *b*, *d*, *e*, *h*, structural details of legs and antenna, in greater enlargement. (From the Division of Entomology, Washington, D. C.)

PLATE I.



FIG. 1.

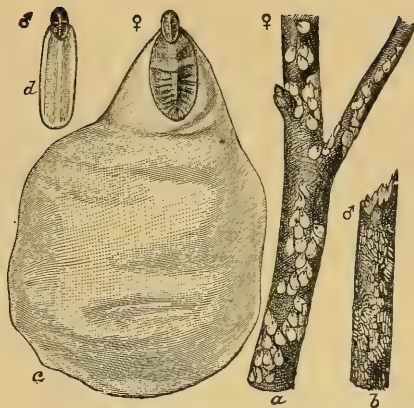


FIG. 2.

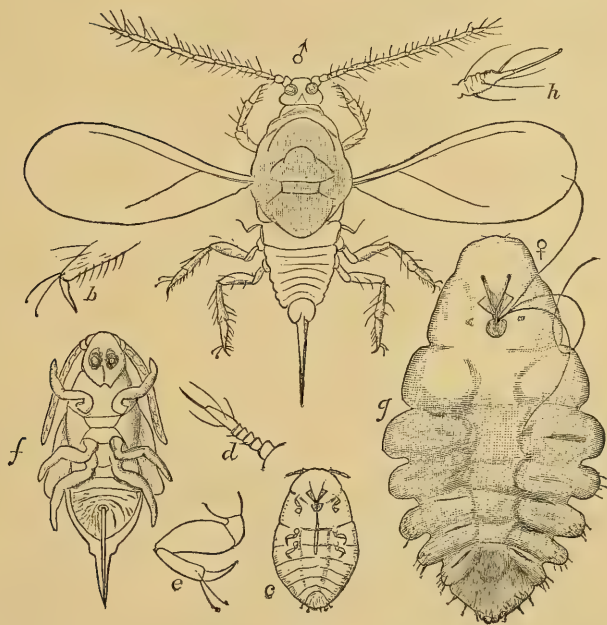


FIG. 3.

EXPLANATION OF PLATE II.

- Fig. 1.—The pine-leaf scale-insect, *Chionaspis pinifolii* (Fitch): *2*, the scales on the leaves in natural size; *a*, leaves not stunted by the presence of the scales; *b*, scale of female of usual form, enlarged; *c*, wide form of the same, enlarged; *d*, a male scale enlarged. (After Comstock.)
- Fig. 2.—The white scale, *Aspidiotus nerii* Bouché, on an Acacia twig, in natural size: *a*, the male insect, enlarged; *b* and *c*, the male and female scales, enlarged. (After Comstock.)

PLATE II.

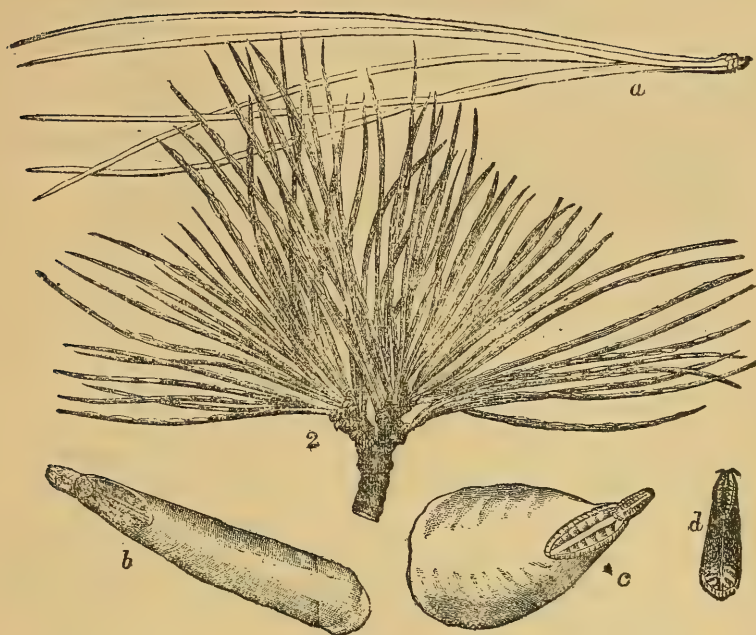


FIG. 1.

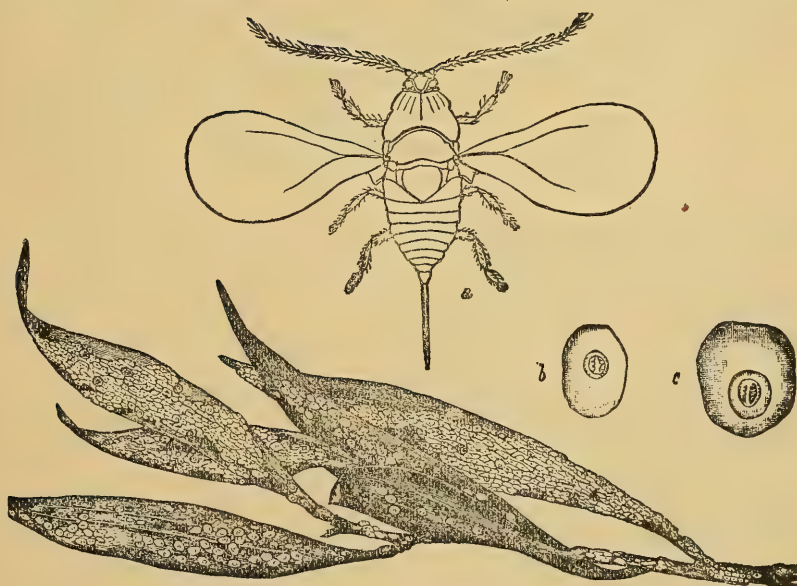


FIG 2.

EXPLANATION OF PLATE III.

- Fig. 1.**—The maple-tree scale-insect, *Pulvinaria innumerabilis* (Rathvon), with extruded egg-masses, on grape, natural size. (After Comstock.)
- Fig. 2.**—The same, on osage orange and on maple. (After Walsh and Riley.)
- Fig. 3.**—The same: *a*, a twig with mature female scales and egg-masses, natural size; *b*, mature female scale from above, enlarged; *c*, female scale from below, more enlarged; *d*, the thread-like setæ of the proboscis. (From the Seventh Report on the Insects of Illinois.)
- Fig. 4.**—The same: *a*, a twig with half-grown female scales, in natural size; *b*, autumnal female scale from above, enlarged; *c*, the same from beneath; *d*, the male insect enlarged. (From the Seventh and Thirteenth Illinois Reports.)

PLATE III.



FIG. 1.



FIG. 2.

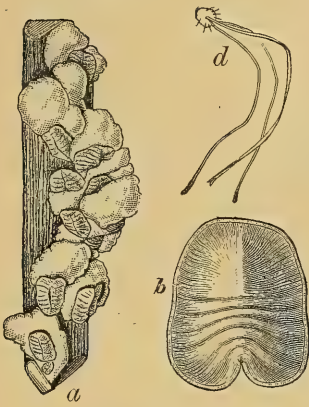


FIG. 3.

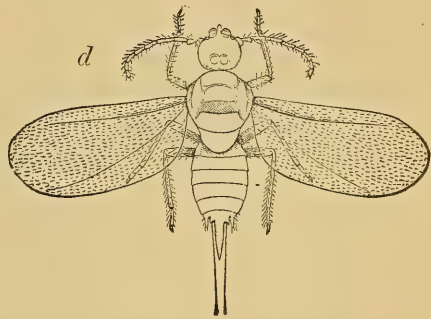
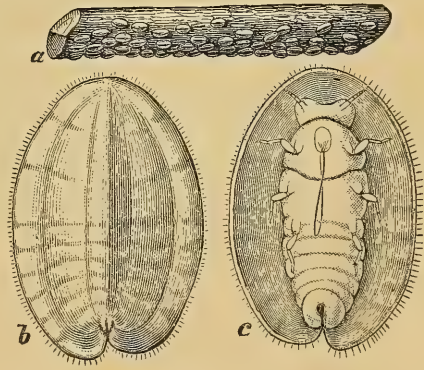
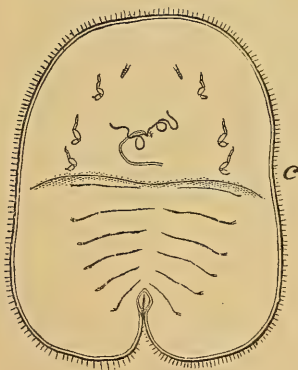


FIG. 4.



EXPLANATION OF PLATE IV.

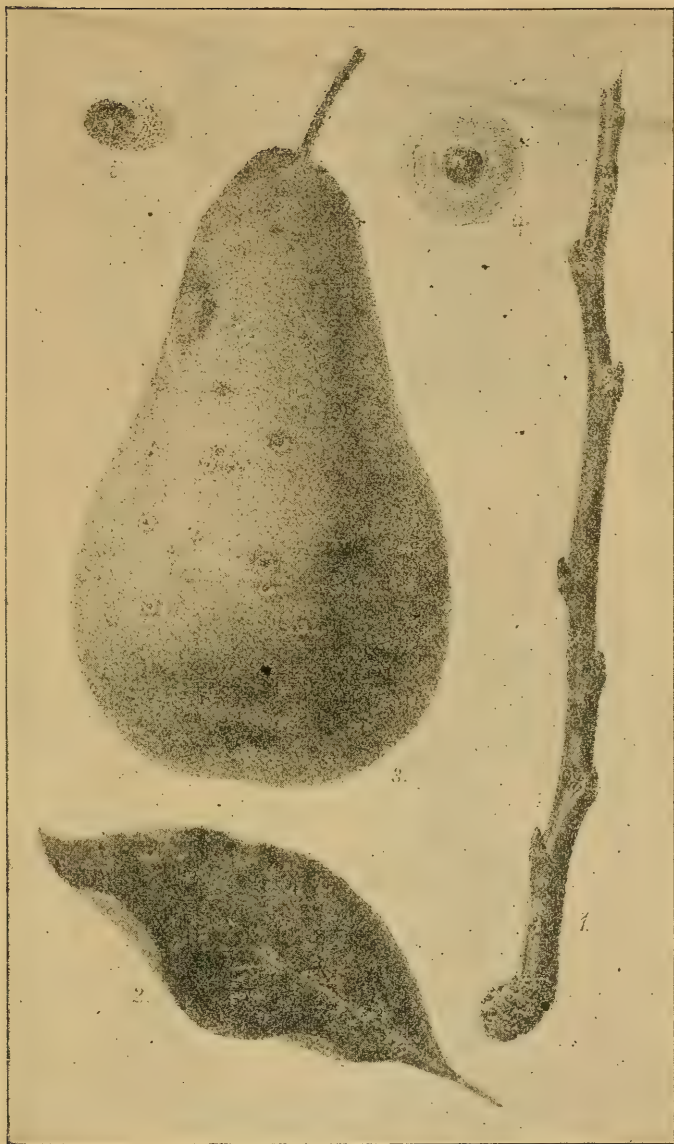
The plum-tree scale-insect, *Lecanium ? juglandis* Bouché in natural size, on plum. (From Garden and Forest.)

PLATE IV.



EXPLANATION OF PLATE V.

Fig. 1, the San José scale, *Aspidiotus perniciosus* Comstock, infesting a pear twig; 2, the scales on a leaf; 3, scattered scales on a pear; 4, a female scale, enlarged; 5, a male scale, enlarged. (From the Cornell University Agr. Exper. Station, and by permission of the California State Board of Horticulture.)



EXPLANATION OF PLATE VI.

- Fig. 1.**—The San José scales, in natural size on an apple branch; scales somewhat enlarged on apple bark at above at the left.
- Fig. 2.**—San José scales on a pear showing the surrounding ring; *b*, a female scale, enlarged.

PLATE VI.



FIG. 1.

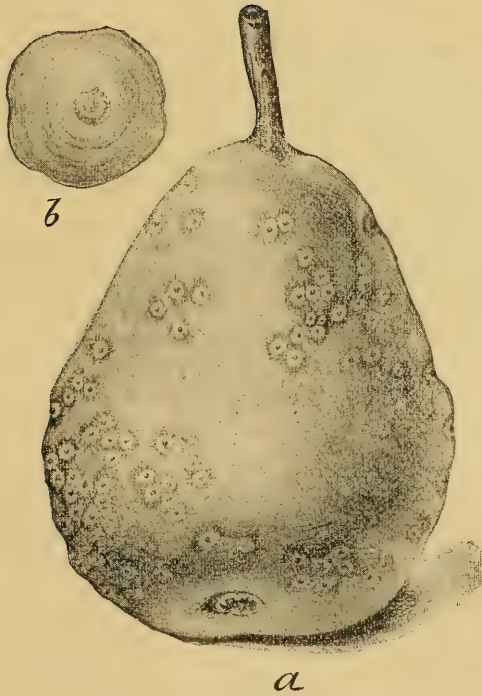


FIG. 2.

EXPLANATION OF PLATE VII.

- Fig. 1.**—Enlarged view of the young larva of the San José scale-insect, seen from beneath, with a greater enlargement of an antenna at *b*.
- Fig. 2.**—An enlarged view of an adult female of the San José scale-insect, containing young; at *d*, a still greater enlargement of a portion of its anal fringe.
- Fig. 3.**—A greatly enlarged view of the adult male of the San José scale-insect; its natural size shown in the inclosed crossed-lines at right-hand side.
- (The figures of this Plate and the preceding one are from the U. S. Dept. Agriculture—Division of Entomology.)

PLATE VII.

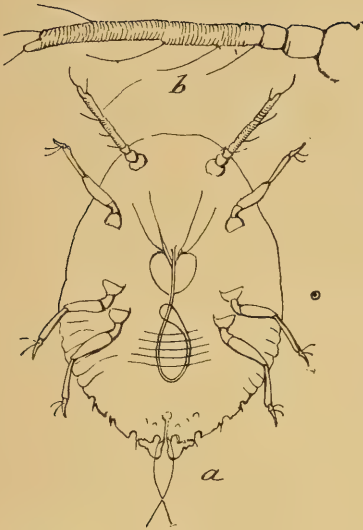


FIG. 1.

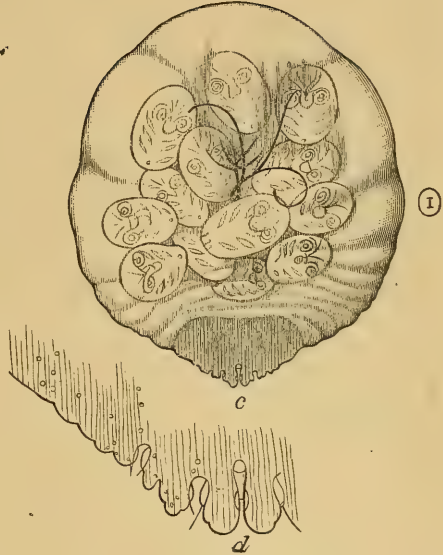


FIG. 2.

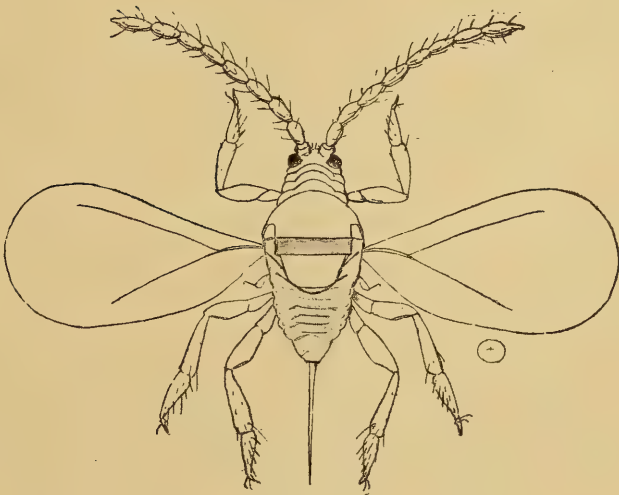


FIG. 3.

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